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Research Article

A new species of *Nitocra* Boeck, 1865 (Copepoda, Harpacticoida) from Vietnam

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Abstract

An undescribed taxon of the species-rich genus *Nitocra* was found during a survey on the harpacticoid copepods from the hyporheic zone in Vu Gia–Thu Bon Rriver, Central Vietnam. The new species, *N. duyxuyenensis* **sp. nov.**, is morphologically similar to the American *N. evergladensis* Bruno & Reid, 2002. These two species can be separated by the number of marginal spinules on the anal operculum, the relative length of the baseo-endopod of the female fifth leg, the structure of the antenna, the number of setae on the female fifth leg, the number of setae on the inner margin of the first endopodal segment of the second to fourth swimming legs of the males, and the number of setae on the third endopodal segment of the third swimming leg. Additionally, some comments on the groups and subgroups of the genus defined so far are given, with the proposal of the *lacustris* species subgroup for group III of Gómez et al. (2012).

Key words: Groundwater fauna, hyporheic zone, new species, *Nitokra*, Southeast Asia, species groups, taxonomy

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Introduction

With 74 species and 26 subspecies, the genus *Nitocra* Boeck, 1865 is one of the genera with the largest number of species in the family Ameiridae. Of these, nine species (*N. arctolongus* Shen & Tai, 1973; *N. karanovici* Chullasorn, Kangtia & Klangsin, 2014; *N. koreanus* Chang 2007; *N. malaica* Kiefer, 1929; *N. platypus platypus* Daday, 1906; *N. platypus bakeri* Chappuis, 1930; *N. sewelli* Gurney, 1927; *N. vietnamensis* Tran & Chang, 2012; *N. quangnamensis* Tran, Trinh-Dang, Nguyen & Brancelj, 2025) have been found in Asia. Species of *Nitocra* are common in several kinds of soft bottoms in fresh-water, brackish, and marine habitats (Boxshall and Halsey 2004).

Records of the genus *Nitocra* from Vietnam are still scarce, and only two species, *N. vietnamensis* found in anchialine caves at Ninh Binh province (Tran and Chang 2012), and *N. quangnamensis* found in the hyporheic zone of the Vu Gia-Thu Bon River in Quang Nam Province (Tran et al. 2025b), had been reported from this region. Here we describe a new species, *N. duyxuyenensis* sp. nov., collected from the hyporheic zone in Vu Gia–Thu Bon river (Quang Nam province), Central Vietnam.

Materials and methods

Harpacticoid copepods were collected from the hyporheic zone in Vu Gia–Thu Bon river, Quang Nam province, Central Vietnam, by the Karaman-Chappuis method (Karaman 1934; Chappuis 1942). Samples were filtered with a standard zooplankton net with a 50-µm mesh, and subsequently fixed and preserved in 4% formalin. Dissected specimens were mounted in glycerin, and the slides were sealed with transparent nail varnish. Dissected appendages and body ornamentation were examined at 1000 × magnification under an Axio Lab A1 Carl Zeiss compound microscope. All drawings were digitally inked using CORELDRAW v. 19.0®.

Morphological nomenclature follows Huys and Boxshall (1991). Abbreviations used throughout the text are **A1**, antennule; **A2**, antenna; **ae**, aesthetasc; **Exp**, exopod; **Enp**, endopod; **Benp**, baseoendopod; **P1–P6**, first to sixth thoracopod; **Exp(Enp)-1(2, 3)** denotes the proximal (middle, distal) segment of a ramus.

The type material was deposited at the Zoological Collection of Duy Tan University (**ZC-DTU**), Da Nang city, Vietnam.

Two different spellings, *Nitocra* and *Nitokra,* have been widely used [see Gómez in litt., Huys in litt. (Walter and Boxshall 2025)]. The spelling *Nitokra* is regarded as the alternative representation of *Nitocra,* and both are in use (Walter and Boxshall 2025). Here we adopt the spelling *Nitocra* Boeck, 1865 over *Nitokra* Boeck, 1865.

Taxonomy

Family Ameiridae Boeck, 1865

Genus *Nitocra* Boeck, 1865

Type species. *Nitocra typica typica* Boeck, 1865.

Other species. *Nitocra affinis* Gurney, 1927; *N. alperi* Yıldız & Karaytuğ, 2024; *N. arctolongus* Shen & Tai, 1973; *N. australis* Soyer, 1975; *N. balli* Rouch, 1972; *N. balnearia* Por, 1964; *N. bdellurae* (Liddell, 1912); *N. bisetosa* Mielke, 1993; *N. blochi* Soyer, 1975; *N. californica* Lang, 1965b; *N. cari* Petkovski, 1954; *N. chelifer* Wilson, C. B., 1932; *N. colombiensis* Fuentes-Reinés & Suárez-Morales, 2014; *N. delaruei* Soyer, 1975; *N. divaricata caspica* Behning, 1936; *N. divaricata divaricata* Chappuis, 1924; *N. dubia* Sars, G. O., 1927; *N. elegans* (Scott, T., 1905); *N. elongata* Marcus, 1968; *N. esbe* Karanovic, Eberhard, Cooper & Guzik, 2015; *N. evergladensis* Bruno & Reid, 2002; *N. fallaciosa baltica* Lang, 1965a; *N. fallaciosa fallaciosa* Klie, 1937; *N. fluviatilis* Galhano, 1968; *N. fragilis fragilis* Sars, G. O., 1905, *N. fragilis paulistana* Jakobi, 1956; *N. galapagoensis* Mielke, 1997; *N. hamata* Bodin, 1970; *N. hibernica bulgarica* (Apostolov, 1976); *N. hibernica hibernica* (Brady, 1880); *N. hibernica hyalina* Jakubisiak, 1929; *N. humphreysi* Karanovic & Pesce, 2002; *N. husmanni* Kunz, 1976; *N. hyperidis* Jakobi, 1956; *N. karanovici* Chullasorn, Kangtia & Klangsin, 2014; *N. kastjanensis* Kornev & Chertoprud, 2008; *N. koreanus* Chang, 2007; *N. lacustris azorica* Kunz, 1983; *N. lacustris colombianus* Reid, 1988; *N. lacustris lacustris* (Schmankevitsch 1875); *N. lacustris pacifica* Yeatman, 1983; *N. lacustris sinoi* Marcus & Por, 1961; *N. laingensis* Fiers, 1986; *N. langi* Karanovic, Eberhard, Cooper & Guzik, 2015; *N. loweae* Yıldız & Karaytuğ, 2024; *N. malaica* Kiefer, 1929; *N. marinae* Jaschnov,

1935; *N. mediterranea jakubisiak* Karanovic, Eberhard, Cooper & Guzik, 2015; *N. mediterranea mediterranea* Brian, 1928; *N. medusaea* Humes, 1953; *N. minor* Willey, 1930; *N. mozambica* Huys, 2021; *N. oligochaeta* Giesbrecht, 1882; *N. phlegraea* Brehm, 1909; *N. phreatica* Bozic, 1964; *N. pietschmanni* Chappuis, 1933; *N. platypus platypus* Daday, 1906; *N. platypus bakeri* Chappuis, 1930; *N. pontica* Boeck, 1865; *N. pori* Karanovic, Eberhard, Cooper & Guzik, 2015; *N. psammophila* Noodt, 1952; *N. pseudospinipes* Yeatman, 1983; *N. puebloviejensis* Fuentes-Reinés, Suárez-Morales & Silva-Briano, 2022; *N. pusilla mediterranea* Brian, 1928; *N. pusilla pusilla* Sars, G. O., 1911; *N. quadriseta* Wells & Rao, 1987; *N. quangnamensis* Tran, Trinh-Dang, Nguyen & Brancelj, 2025; *N. reducta* Schäfer, 1936; *N. reunionensis* Bozic, 1969; *N. rijekana* Petkovski, 1954; *N. salina* (Schmankevitsch, 1875); *N. serdarsaki* Yıldız & Karaytuğ, 2024; *N. sewelli* Gurney, 1927; *N. simplex* Schmeil, 1894; *N. sonmezi* Yıldız & Karaytuğ, 2024; *N. sphaeromata* Bowman, 1988; *N. spinipes orientalis* Sewell, 1924; *N. spinipes spinipes* Boeck, 1865; *N. stygia* Por, 1968; *N. taylori* Gómez, Carrasco & Morales-Serna, 2012; *N. tenuicornis* Brady & Robertson, 1873; *N. typica adriatica* Petkovski, 1954; *N. typica pontica* Jakubisiak, 1938; *N. uenoi* Miura, 1962; *N. vietnamensis* Tran & Chang, 2012; *N. wolterecki* Brehm, 1909; *N. yahiai* (Blanchard & Richard, 1891); *N. yeelirrie* Karanovic, Eberhard, Cooper & Guzik, 2015.

Nitocra duyxuyenensis sp. nov.

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Figs 1–9

Type material. • Adult female ***holotype*** dissected and mounted on one slide (ZC-DTU-COPEPODA-0014) • adult male ***allotype*** dissected and mounted on one slide (ZC-DTUCOPEPODA-0015) • two female and two male ***paratypes*** preserved in 70% ethanol (ZC-DTU-COPEPODA-0013).

Type locality. Hyporheic zone in Vu Gia – Thu Bon river (15°50'15"N, 108°09'05"E), Quang Nam province, Central Vietnam.

Differential diagnosis. Caudal rami 1.2× as long as wide. Anal operculum with six marginal spinules. Female antennule eight-segmented; male antennule haplocer, eight-segmented. Antenna with allobasis. P1 Exp-2 with inner seta; Exp-3 with five elements in all; P1 Enp-1 reaching approximately the middle of Exp-2, with inner seta; Enp-2 with three elements. P2–P4 Exp-2 with inner seta, Exp-3 with seven setae/spines; P2–P4 Enp-1 without, Enp-2 with inner seta, Enp-3 with four, five, and five setae/spines respectively. Female P5 Exp with six, Benp with five setae and reaching the middle of Exp; male P5 Exp with six, baseoendopods fused medially, each with three setae.

Description of the adult female. ***Habitus*** (Fig. 1A) semicylindrical; total body length measured from tip of rostrum to posterior margin of caudal rami ranging from 492 to 546 µm (average = 519 µm, *n* = 5; holotype = 546 µm). Nauplius eye not visible. Rostrum (Fig. 1A) linguiform, small, not reaching end of first antennule segment, with pair of tiny sensilla subapically. Prosome four-segmented, comprising cephalothorax with completely fused first pedigerous somite, and three free pedigerous somites; cephalothorax and P2–P4-without surface ornamentation other than sensilla as shown (Fig. 1A). Urosome five-segmented, comprising fifth pedigerous somite, genital double-somite, two free uroso-

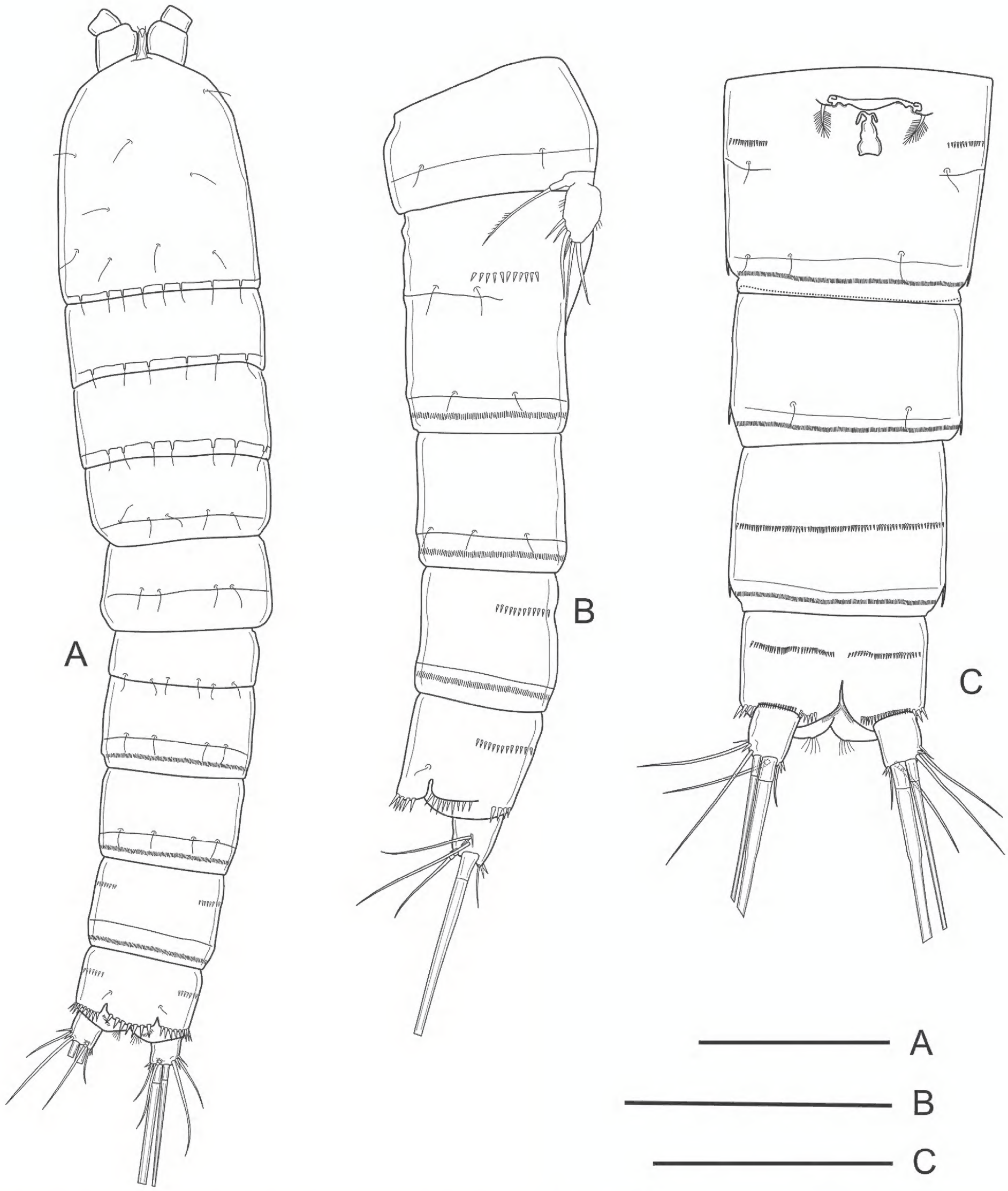

Figure 1. *Nitocra duyxuyenensis* sp. nov. Female, holotype. **A.** Habitus, dorsal; **B.** Urosome, lateral; **C.** Urosome, ventral (P5-bearing somite omitted). Scale bars: 100 µm.

mites, and anal somite with caudal rami (Fig. 1A, B); P5-bearing somite without spinular ornamentation, with few posterior sensilla; genital double-somite (Fig. 1A–C) formed by the fusion of genital and third urosomite, with dorsolateral suture indicating original division, completely fused ventrally, proximal half with dorsolateral sensilla close to suture and with short row of lateral spinules as depicted (Fig. 1B), ventrally with medially interrupted row of minute spinules and

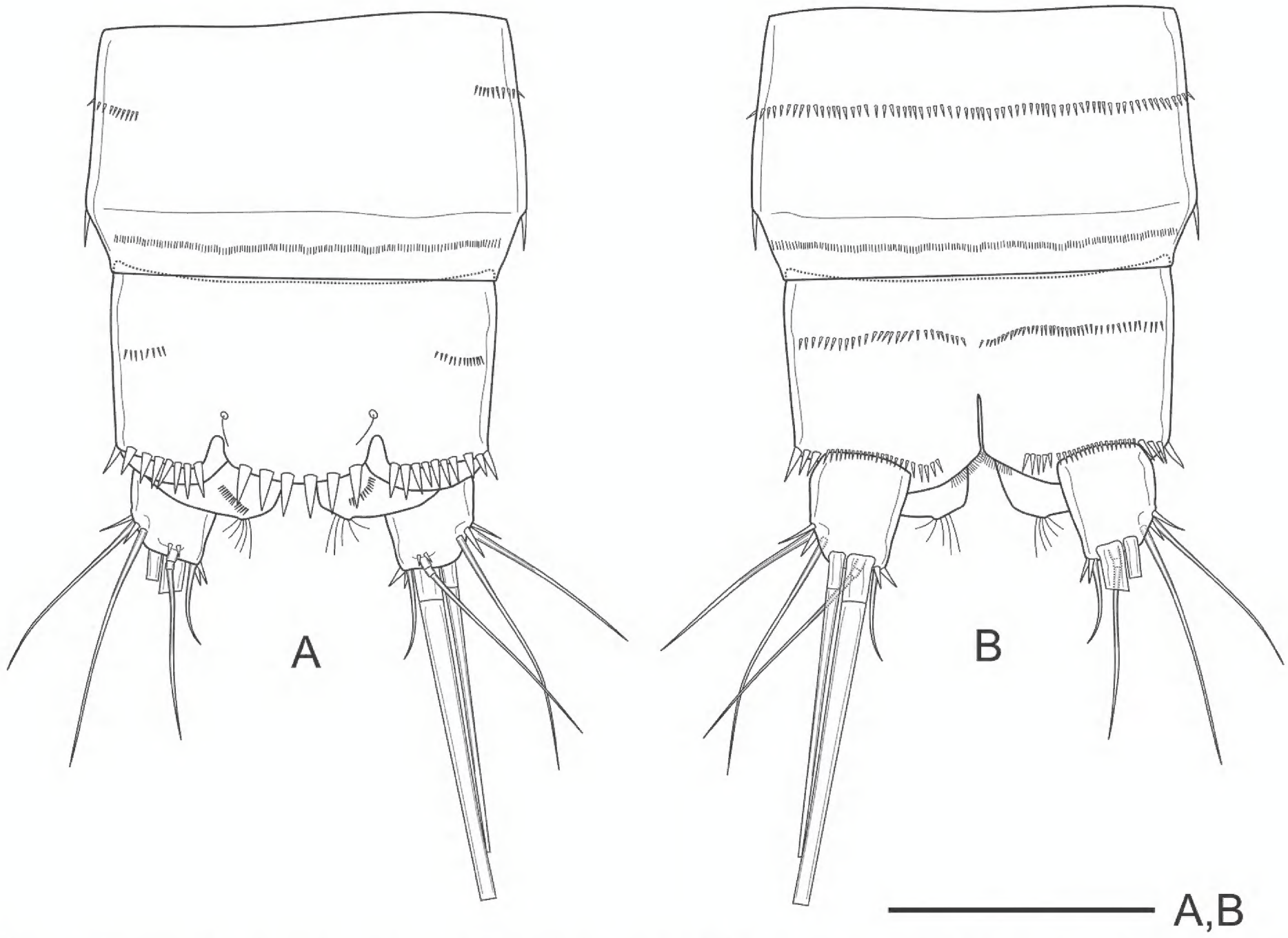

Figure 2. *Nitocra duyxuyenensis* sp. nov. Female, holotype. **A.** Fifth urosomite, anal somite and caudal rami, dorsal; **B.** Fifth urosomite, anal somite and caudal rami, ventral. Scale bar: 50 µm.

with sensilla along partial ventral suture, genital field close to anterior margin of first half of somite (Figs 1C, 6B), with large median copulatory pore; fourth urosomite with posterior spinular row ventrally (Fig. 1C); fifth urosomite with medial ventrolateral row of small spinules and with continuous row of small ornaments close to posterior margin, without sensilla (Fig. 2A, B); anal somite (Figs 1A, 2A, B) with median ventrolateral row of spinules, with strong spinules close to caudal rami dorsally (Figs 1A, 2A), and with comparatively smaller ornaments ventrally (Fig. 2B), anal operculum semicircular with six strong marginal spinules and flanked by pair of sensilla (Figs 1A, B, 2A). Caudal rami (Figs 1B, C, 2A, B) short, subquadrate, 1.2× as long as wide, with seven elements each; anterolateral seta I slender, short, ~0.3× as long as caudal ramus; anterolateral seta II and posterolateral seta III smooth, the former slightly shorter than the latter, with short strong spinules at base of seta II; outer apical seta IV and middle apical seta V well-developed, with fracture planes, seta V longest; distal inner accessory seta VI slender, smooth, 0.9 as long as caudal ramus, with several small spinules at its base; dorsal seta VII tri-articulated, ~2.4× as long as caudal ramus, issuing close to posterior margin of ramus.

Antennule (Fig. 3A) 8-segmented, long and slender; all segments smooth except for first segment with a row of spinules; all setae smooth except for pinnate seta on first segment. Aesthetasc on fourth segment, fused to long seta, reaching well beyond distal end of last segment. Armature formula as follows: 1(1), 2(7), 3(2), 4(2+(1+ae)), 5(2), 6(1), 7(4), 8(5+acrothek).

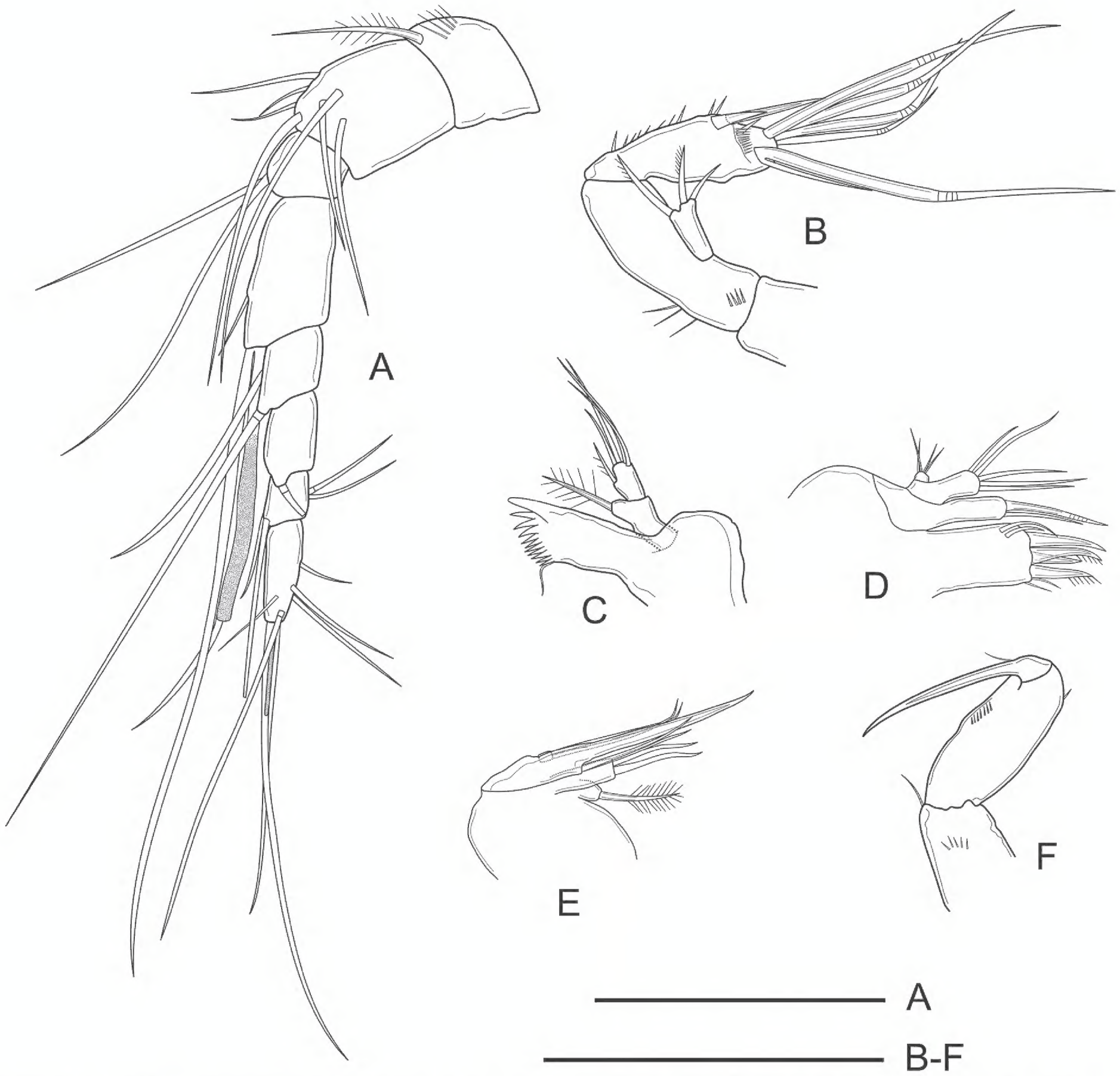

Figure 3. *Nitocra duyxuyenensis* sp. nov. Female holotype. **A.** Antennule; **B.** Antenna; **C.** Mandible; **D.** Maxillule; **E.** Maxilla; **F.** Maxilliped. Scale bars: 50 µm.

Antenna (Fig. 3B) relatively short, composed of coxa, allobasis, one-segmented endopod, and one-segmented exopod. Coxa short, unornamented. Allobasis 2.7× as long as wide, with a short row of inner spinules proximally, and several minute proximal spinules close to coxa. Exopod with three distal unequal setae (one bare, two unipinnate). Endopod with inner longitudinal spinular row; lateral armature consisting of one inner spine and one strong inner seta; distally with one smooth seta, four geniculate setae and one distal outer geniculate seta fused basally to slender element.

Mandible (Fig. 3C) with well-developed coxa; gnathobase with ~11 teeth as shown, and single lateral seta. Mandibular palp 2-segmented, first segment (basis) with one strong plumose seta; endopod with one lateral and four smooth apical setae.

Maxillule (Fig. 3D) with well-developed praecoxa; arthrite with two surface setae, and four large robust distal spines. Coxal endite with two smooth setae.

Basis with five normal unequal setae distally. Endopod 1-segmented, with four slender smooth setae.

Maxilla (Fig. 3E) without spinular ornamentation on syncoxa, the latter with two endites; proximal endite somewhat bulbous, with one strong plumose seta; distal endite cylindrical, with three subequal setae. Allobasis drawn out into long claw accompanied by a shorter bare seta. Endopod short, one-segmented; with two subequal, smooth setae.

Maxilliped (Fig. 3F) with short and stout syncoxa, the latter 1.3× as long as wide, with short row of posterior spinules, with one small bare seta subapically. Basis ~2.2× as long as wide, with short row of inner spinules and with one outer subdistal spinule. Endopod drawn out into long curved smooth claw accompanied by single short slender seta.

P1–P4 (Figs 4A, B, 5A, B) with short unornamented intercoxal sclerites, the latter with dorsal tines as shown. Coxa of P1 and P2 with, of P3 and P4 without outer subdistal spinules. Basis of P1 with spinules at the base of inner and outer spine, with additional ornaments between rami; basis of P2–P4 with spinules at the base of outer spiniform (P2) and setiform elements (P3–P4), of P2 and P3 with, of P4 seemingly without spinules close to the base of the endopod. Rami three-segmented. Exopodal segments with outer and subdistal spinules as shown; Exp-1 with outer spine, without inner armature; Exp-2 with outer spine and inner seta; Exp-3 with three outer spines, two distal geniculate setae and without inner armature (P1) or with one distal outer spiniform and one distal inner setiform element and with two inner setae (P2–P4). Endopodal segments with outer ornaments as figured; P1 Enp visibly longer than Exp, Enp-1 not reaching beyond Exp-2; Enp-1–2 with inner seta, Enp-3 with three elements; P2–P4 Enp shorter than Exp; P2–P3 Enp reaching distal tip of Exp-2, P4 Enp reaching slightly above the middle of Exp-2; Enp-1 short, wider than long, unarmed; Enp-2 with one inner seta and a projection at the inner distal corner; Enp-3 with one (P2) or two (P3 and P4) inner setae, two distal elements, and one outer spine; length ratio of armature elements on P3 Enp-3 (starting from outer most apical spine) 1: 1.9:4.7:5.2:2.9. Armature formula of P1–P4 as in Table 1.

Table 1. Armature formula of swimming legs (P1–P4) of *Nitocra duyxuyenensis* sp. nov.

Leg	Basis	Exp			Enp		
		1	2	3	1	2	3
P1	I-I	I-0	I-1	III,2,0	0-1	0-1	I,1,1
P2	0-I	I-0	I-1	III,2,2	0-0	0-1	I,2,1
P3	0-1	I-0	I-1	III,2,2	0-0	0-1	I,2,2
P4	0-1	I-0	I-1	III,2,2	0-0	0-1	I,2,2

P5 (Fig. 6A) with exopod and baseoendopod separated. Baseoendopod with outer unipinnate seta; endopodal lobe well-developed, with longitudinal row of outer spinules, with three inner spinulose spines, and two robust distal setae of which distal inner longest. Exopod oval, 1.6× as long as wide, with six unequal smooth setae of which two outer and outer subdistal seta shortest.

P6 (Fig. 6B) represented by narrow plate with one single plumose seta on each side.

Description of the adult male. Body shape and general appearance as in female (Fig. 7A); total body length measured from tip of rostrum to posterior

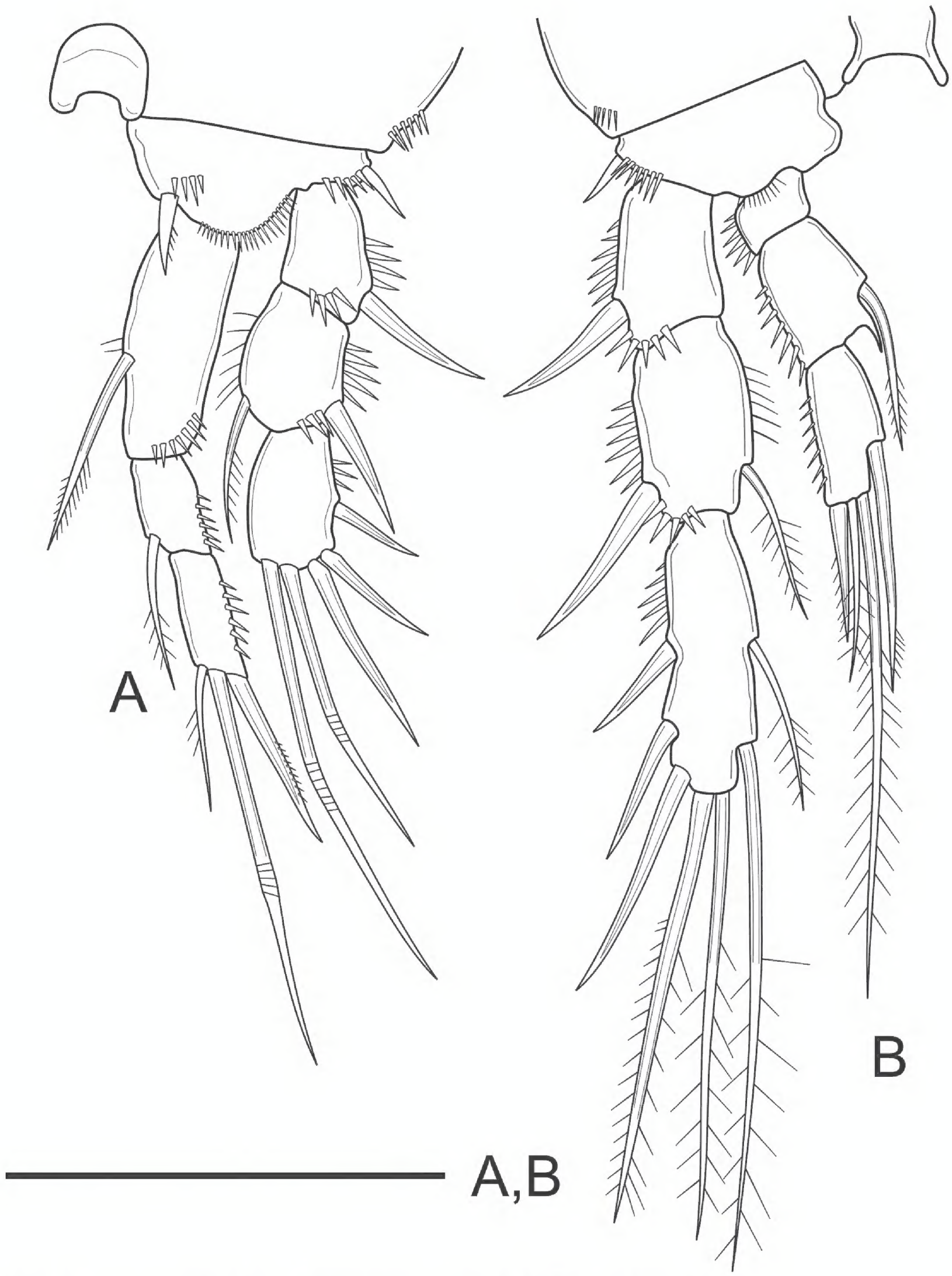

Figure 4. *Nitocra duyxuyenensis* sp. nov. Female, holotype. **A.** P1; **B.** P2. Scale bar: 50 µm.

margin of caudal rami ranging from 476 to 508 µm (average = 492 µm, *n* = 2; holotype = 508 µm). Rostrum, prosomites, anal operculum, and caudal rami as in female (Fig. 7A, C, D). Sexual dimorphism expressed in urosomal segmentation (genital and third urosomite not fused), spinular ornamentation of urosomites, antennule, basis of P1, P5, and P6.

Genital somite (Fig. 7A, B) with continuous posterior dorsolateral spinular row; third urosomite with dorsolateral spinular row interrupted ventrolaterally;

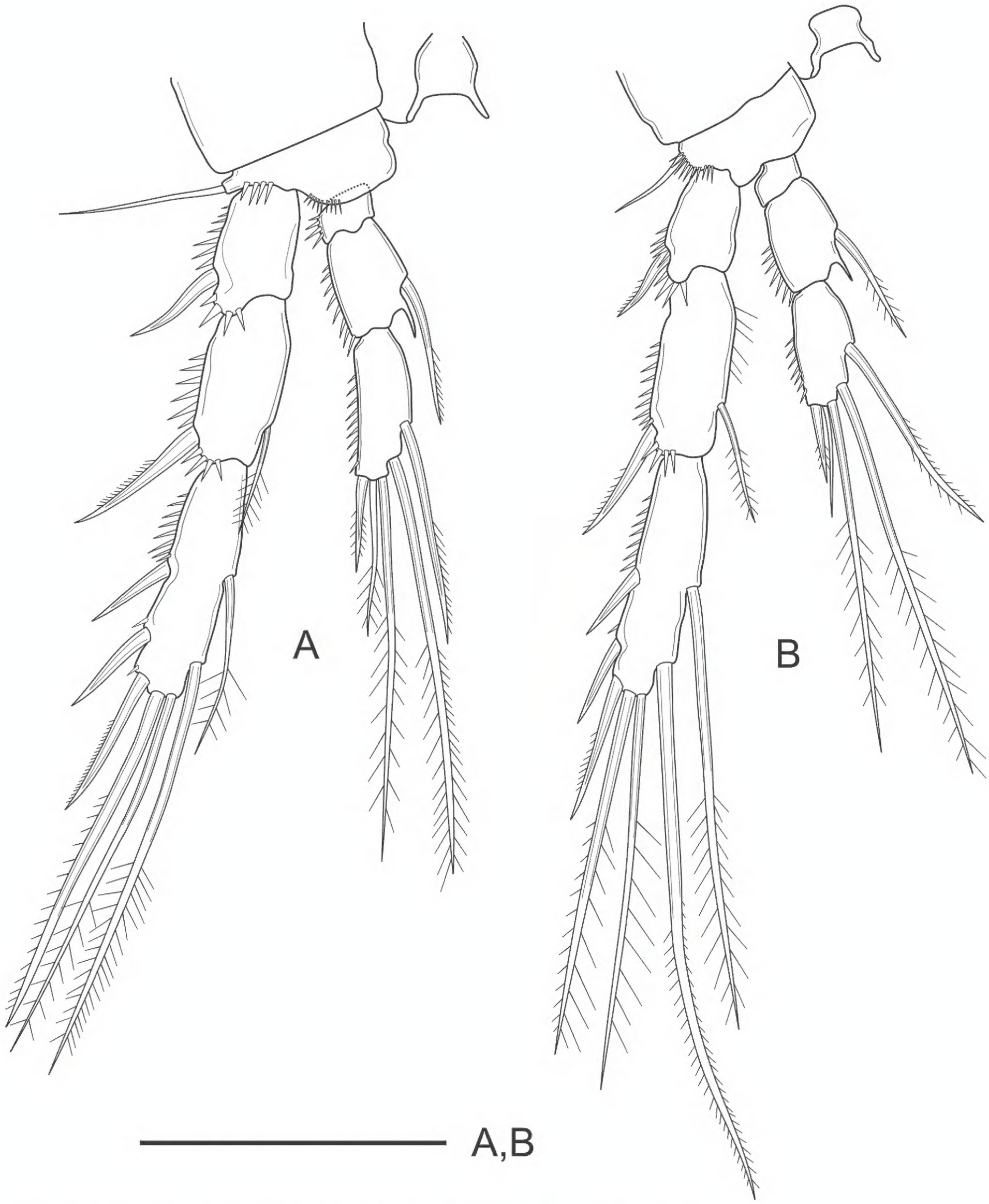

Figure 5. *Nitocra duyxuyenensis* sp. nov. Female holotype. **A.** P3; **B.** P4. Scale bar: 50 µm.

fourth and fifth urosomites (Fig. 1A–D) with continuous posterior and median spinular row, respectively, and fifth urosomite with short spinular row ventrally.

Antennule (Fig. 8A) haplocer, 8-segmented, with geniculation between sixth and seventh segments; all segments smooth except for first segment with some spinules. All setae smooth except for plumose seta on first segment.

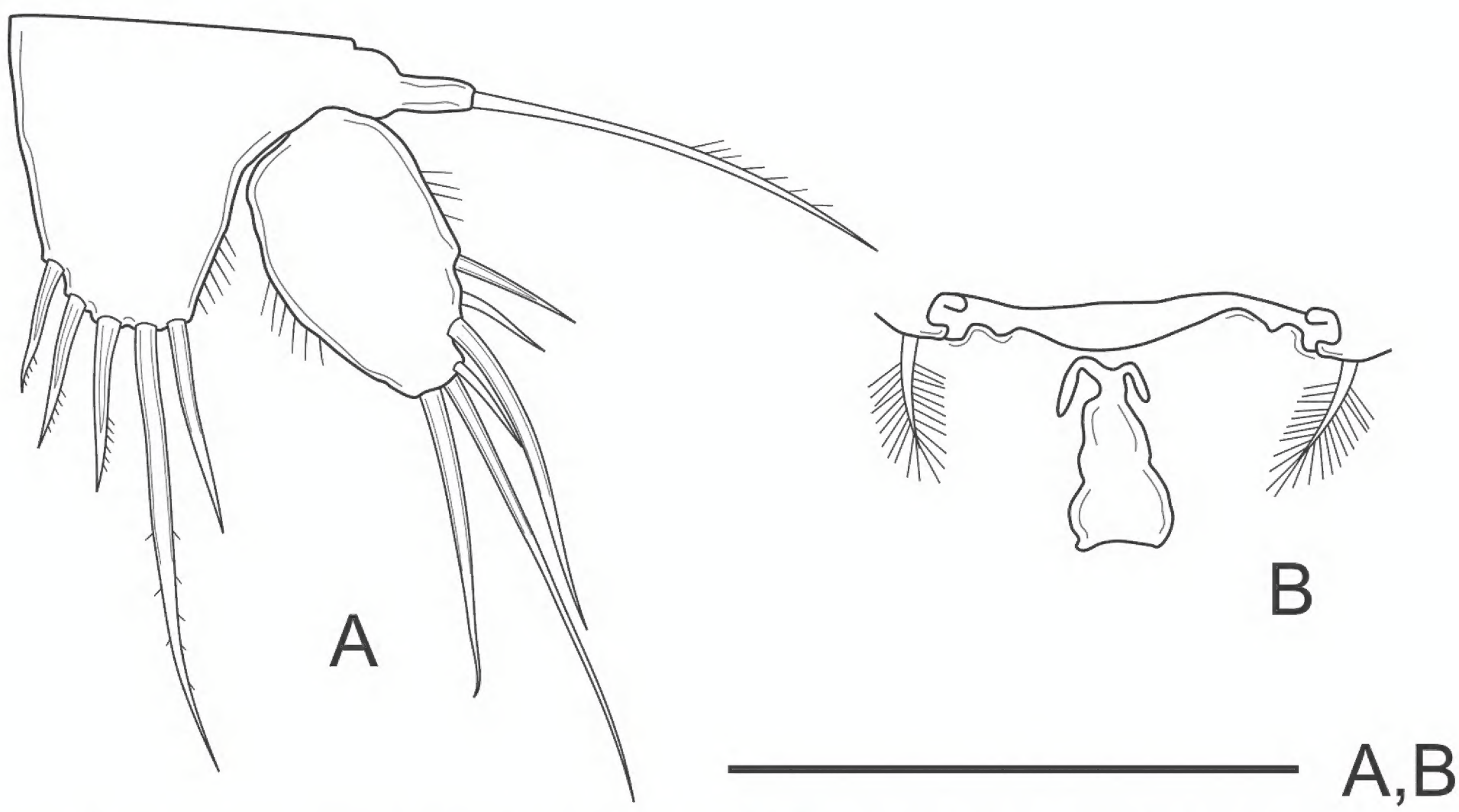

Figure 6. *Nitocra duyxuyenensis* sp. nov. Female holotype. **A.** P5; **B.** P6 and genital complex. Scale bar: 50 µm.

Fourth segment with large aesthetasc fused to long seta overreaching last segment, and with one robust short unipinnate spine. Armature formula as follows: 1(1), 2(8), 3(5), 4(6+(1+ae)), 5(0), 6(1), 7(1), 8(7+acrothek).

Antenna, mandible, maxillule, maxilla, and maxilliped (not shown) as in female.

P1 (Fig. 9A) as in female except for inner spine of basis modified into element with rounded tip; inner margin of Exp-2 and outer margin of Enp-2 naked.

P2 and P4 (not shown) as in female.

P3 (Fig. 9B) as in female except for absence of spinular row on distal margin of basis, and for length ratio of all setae on Enp-3 (1:1.3:1.5:3.6:1.2).

P5 baseoendopods (Fig. 8B) fused medially. Baseoendopod with one outer long smooth seta, endopodal lobe weak, with three naked spiniform setae of which outermost shortest, innermost longest. Exopod with six smooth unequal setae; relative length of exopodal setae (from outermost to innermost seta) 1:0.5:1.2:1.3:0.7:1.8.

P6 (Fig. 8C) small, with two bare unequal setae, of which inner longer.

Variability. No variability was observed.

Discussion

Despite recent advances, the relationships among the species of *Nitocra* are not well understood. Tran and Chang (2012) presented the description of *N. vietnamensis* from a karst area in northern Vietnam, but Gómez et al. (2012) were not aware of this publication and did not include this species in their study in which they split the species of *Nitocra* into three groups based on the combination of the armature formula of P1 Exp2–3.

Group I (*N. sewelli* and *N. platypus bakeri*) was defined by one inner seta and four elements on the P1 Exp-2 and Exp-3, respectively. Group II included *N. reducta*, *N. delaruei*, and *N. blochi*. These species lack inner armature on the P1

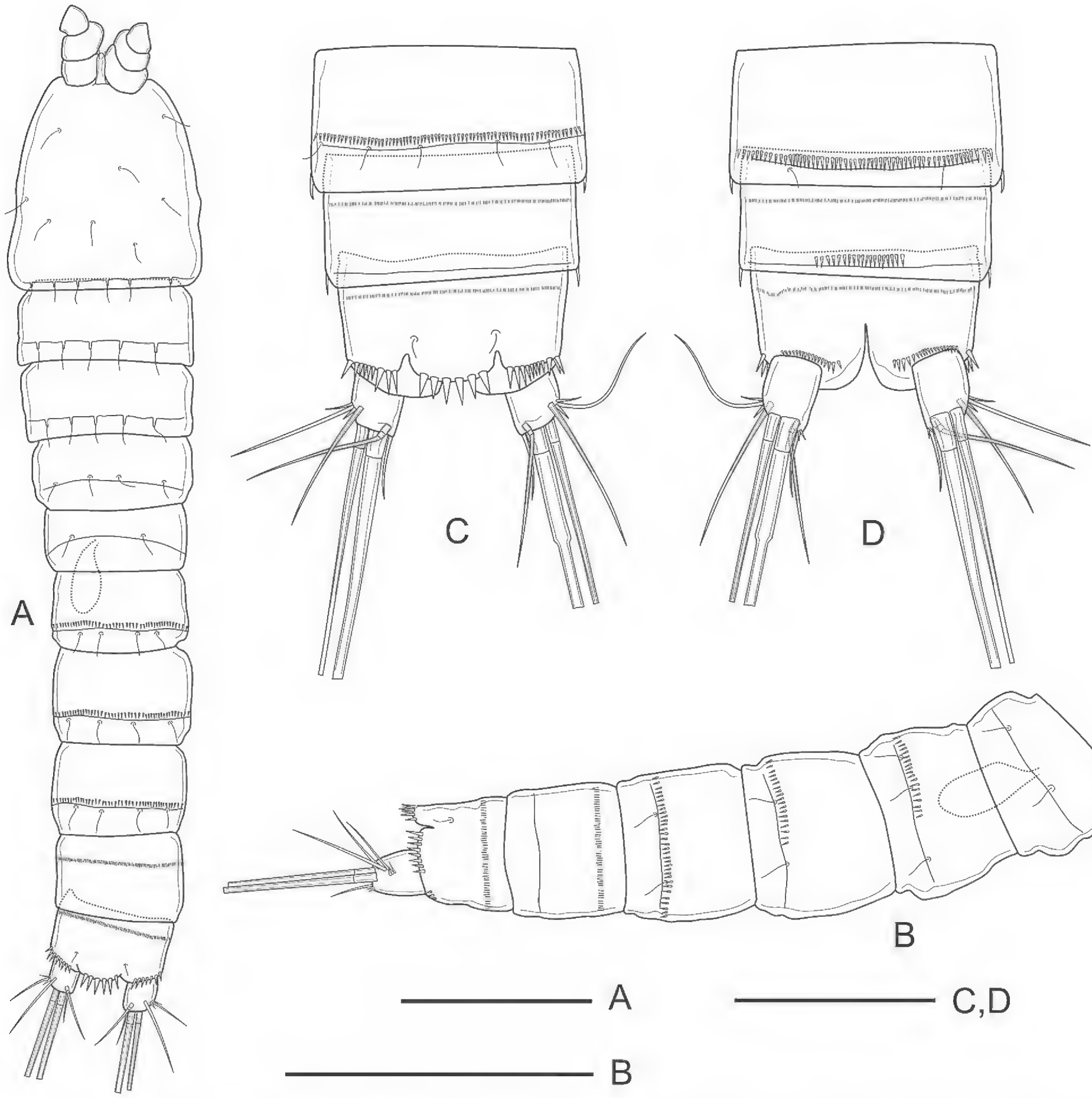

Figure 7. *Nitocra duyxuyenensis* sp. nov. Male allotype. **A.** Habitus, dorsal; **B.** Urosome, lateral; **C.** Fourth and fifth urosomites, and anal somite with caudal rami, dorsal; **D.** Fourth and fifth urosomites, and anal somite with caudal rami, ventral. Scale bars: 100 µm (**A, B**), 50 µm (**C, D**).

Exp-2, but possess five setae on P1 Exp-3. Following Gómez et al. (2012), group III is formed by the remaining species, including *N. vietnamensis*, and was characterized by the presence of one inner, and five elements on the P1 Exp-2 and Exp-3, respectively. They also noticed that some species of this group, viz., *N. taylori*, *N. australis*, *N. fragilis*, *N. spinipes*, *N. intermedia*, and *N. husmanni* are unique in the combination of armature elements of the P2–P4 Enp-3 and P2–P4 Exp-3 (4-5-5, and 7-7-7, respectively) and number of inner setae on the P2–P4 Enp-1 (1-1-1). This subgroup is referred here to as the *fragilis* subgroup.

Several papers on the taxonomy and systematics of *Nitocra* were published after 2012. Fuentes-Reinés and Suárez-Morales (2014) described a new subspecies of *N. affinis*, *N. affinis colombiensis*. Chullasorn et al. (2014) described

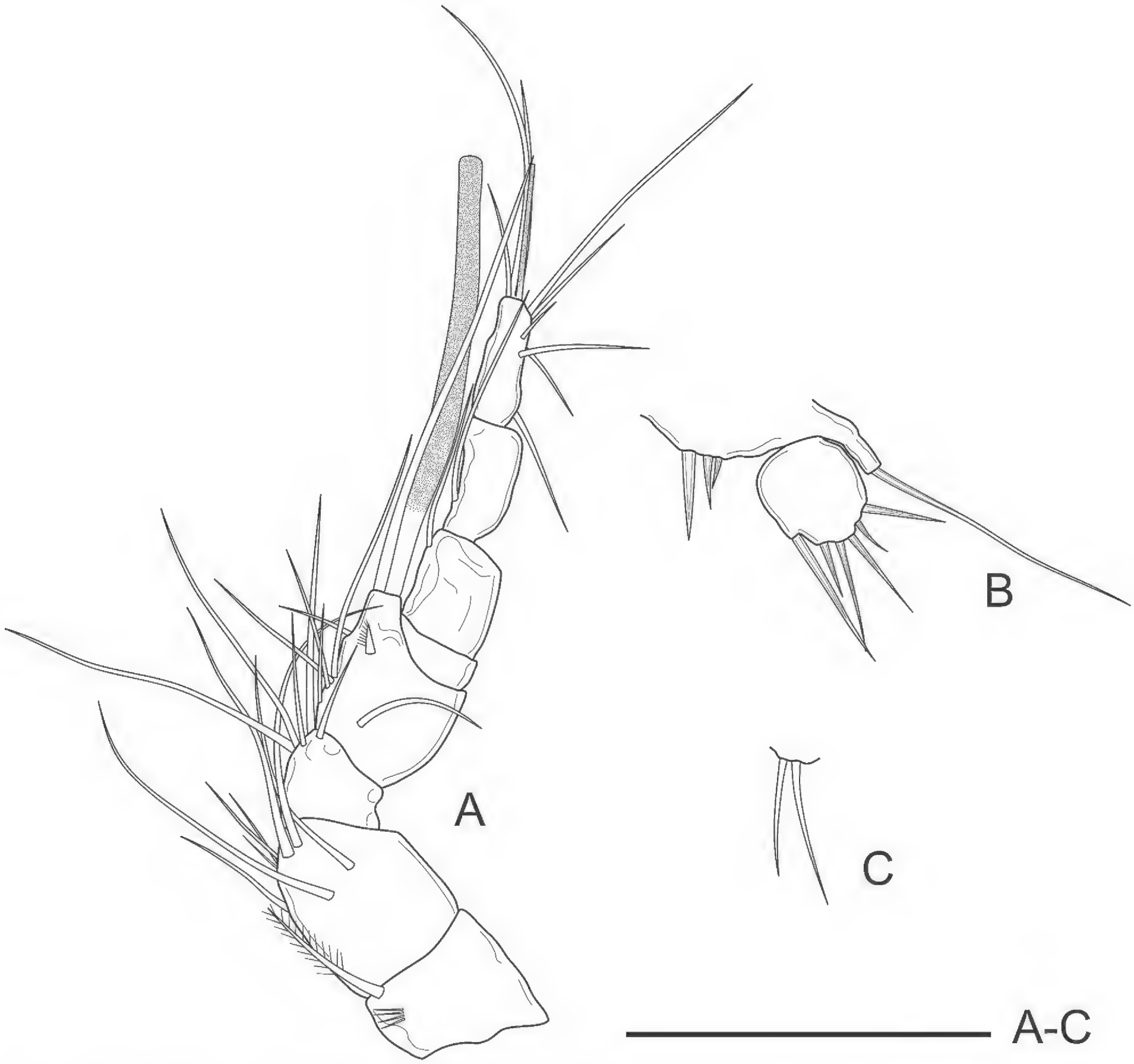

Figure 8. *Nitocra duyxuyenensis* sp. nov. Male allotype. **A.** A1; **B.** P5; **C.** P6. Scale bar: 50 µm.

N. karanovici from washings of the brown alga *Padina australis*. From the detailed description of the species, it is evident that it belongs to Gómez's et al. (2012) group III. Karanovic et al. (2015) gave the description of two species, *N. yeelirrie* and *N. esbe*, from Western Australia, attributed here to Gómez's et al. (2012) group III. Huys (2021) made available Wells' (1967) *N. minor* Willey, 1930 forma *mozambicœ* n. forma as *N. mozambica,* which is placed here in Gómez's et al. (2012) group III. Fuentes-Reinés et al. (2022) described *N. puebloviejensis* from northern Colombia and attributed their new species to Gómez's et al. (2012) group III. *Nitocra puebloviejensis* and *N. taylori*, *N. australis*, *N. fragilis*, *N. spinipes*, *N. intermedia*, and *N. husmanni* share the armature complement of the P2–P4 Enp-3 and P2–P4 Exp-3 (4-5-5, and 7-7-7, respectively) and number of inner setae on the P2–P4 Enp-1 (1-1-1).

In their revision of *N. affinis*, Yıldız and Karaytuğ (2024) described *N. sonmezi* and *N. serdarsaki* from the Turkish coast, *N. alperi* from the Indian Ocean,

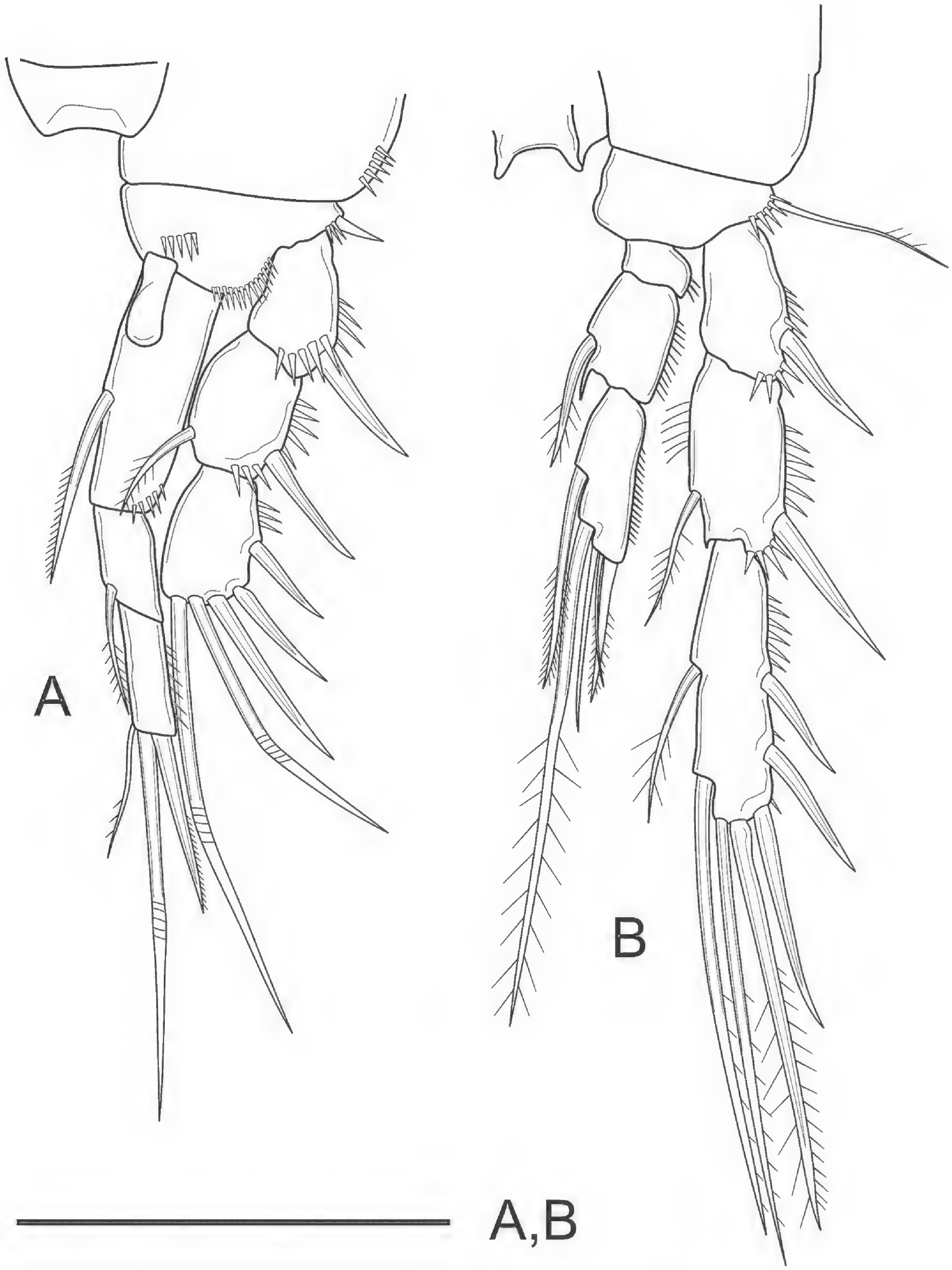

Figure 9. *Nitocra duyxuyenensis* sp. nov. Male allotype. **A.** P1; **B.** P3. Scale bar: 50 µm.

and *N. loweae* from England; they redescribed *N. affinis* and gave full species rank to all its subspecies. They also noticed that some other species of group III of Gómez et al. (2012), viz., *N. affinis*, *N. colombiensis*, *N. rijekana*, *N. stygia*, *N. hamata*, *N. elegans*, *N. sonmezi*, *N. loweae*, *N. serdarsaki*, and *N. alperi*, constitute another subgroup, the *affinis* subgroup sensu Yıldız and Karaytuğ (2024), defined by the combination of i) the presence of a spinulose, long, spine-like inner middle seta on P4 Exp-3, ii) the armature formula of the P2–P4

Exp-3 (7-7-8) and P2–P4 Enp-3 (4-5-5), iii) the presence of an inner seta on the P2–P4 Exp-2, iv) the presence of an inner seta on P2–P4 Enp-1 and Enp-2, and v) the elongated P1 Enp-1.

Tran et al. (2025b) described *N. quangnamensis* from the hyporheic zone of the Vugia-Thubon River in Vietnam. They correctly attributed *N. quangnamensis* to Gómez et al. (2012) group III, but erroneously presented the species as part of Yıldız and Karaytuğ's (2024) *affinis* subgroup in their table 3 [see Tran et al. (2025b: 57)].

Based on the armature complement of Exp-2 and Exp-3 of P1, *Nitocra duyxuyenensis* sp. nov. is placed here into Gómez's et al. (2012) group III but it cannot be included in the *fragilis* (the new species lacks inner armature on P2–P4 Enp-1), or *affinis* subgroup (the new species possesses seven instead of eight elements on P4 Exp-3, lacks the strong middle inner spiniform element on P4 Exp-3 and an inner seta on P2–P4 Enp-1, and possesses a comparatively shorter P1 Enp-1), and the *lacustris* subgroup is proposed herein for *N. balli*, *N. duyxuyenensis* sp. nov., *N. evergladensis*, *N. lacustris pacifica*, and *N. pseudospinipes*. The *lacustris* subgroup is defined by the armature formula of P2–P4 Enp-3 (4-5-5), P2–P4 Exp-3 (7-7-7) and by the lack of inner armature on the P2–P4 Enp-1 in females. A comparative table with the taxa attributed so far to the *affinis*, *fragilis*, and *lacustris* subgroups is presented below (see Tables 2–4). The key characters and character states selected for comparison include i) the relative length of P1 Enp-1, ii) armature formula of P2–P4 Enp-1, iii) armature formula of P2–P4 Enp-3, iv) armature formula of P2–P4 Exp-3, v) the number of inner setae on P4 Exp-3, vi) the setation of P5 Exp/baseoendopod in both females and males, vii) the segmentation of A2 Enp, and viii) the relative length of the female P5 baseoendopod.

Nitocra duyxuyenensis sp. nov. is similar to *N. evergladensis* but they differ in i) the anal operculum (furnished with six spines in both sexes of the new species, but with seven spines in *N. evergladensis*); ii) the relative length of the female P5 baseoendopod (reaching the middle of Exp in *N. duyxuyenensis* sp. nov., but comparatively longer in *N. evergladensis*); iii) A2 with allobasis in the new species, but with basis in *N. evergladensis*; iv) the setal complement of the male P5 Exp/Benp (6/3 in *N. duyxuyenensis* sp. nov., but 7/4 in *N. evergladensis*); v) the number of setae on the inner margin of the male P2–P4 Enp-1 (0-0-0 in the new species, but 1-1-1 in *N. evergladensis*); vi) armature complement of P3 Enp-3 (with four setae and one spine in the new species, but with three setae and one spine in *N. evergladensis*).

Several species (see Table 5) do not fit in any of the subgroups above. Some of them, whose grouping is referred below to as the *mediterranea* subgroup (*N. mediterranea jakubisiak*, *N. mediterranea mediterranea*, *N. typica adriatica*, *N. elongata*, *N. langi*, *N. fluviatilis*) are similar to the *affinis* and *fragilis* subgroups in the presence of an inner seta on P2–P4 Enp-1, but display a reduced number of setae and spines on P2–P4 Enp-3 and Exp-3. Similarly, some other species (*N. kastjanensis*, *N. quadriseta*, *N. cari*, *N. arctolongus*, *N. yeelirrie*, *N. bisetosa*, *N. esbe*) are similar to the *lacustris* subgroup in that they lack inner armature on P2–P4 Enp-1, but also display a reduced number of inner setae on P2–P4 Enp-3 and Exp-3. The phylogenetic relationships among the species of *Nitocra* are far from resolved and an extensive analysis with more (micro)characters might be useful to better understand their relationships.

Table 2. Differentiating characters of the species of the *affinis* subgroup. uk = unknown.

Species	P1 Enp-1	P5 female Exp:Benp	P5 male Exp:Benp	Female P5 Benp	A2	Female P5 Exp	Rostral projection	Inner seta of P1 Enp-1	P1 Enp-3	P5 Benp	Maxilliped syncoxa
	relative length	# setae	# setae	relative length	allobasis/ basis	l/w		position, ornamentation, and relative length	# setae	Hyaline area	# setae
N. affinis	beyond Exp-3	6:5	6:4–5	1/2 Exp	allobasis	1.8	with	2/3 Enp-1; bipinnate; > Enp	3	without	1
N. californica	beyond Exp-3	6:5	6:4	2/3 Exp	uk	2–2.2	uk	2/3 Enp-1; unipinnate; ~Enp	3	without	uk
N. colombiensis	beyond Exp-3	6:5	6:3	1/2 Exp	basis	1.6	with	1/4 Enp-1; bipinnate; > Enp	3	without	1
N. rijekana	uk	6:5	6:5	1/2 Exp	uk	uk	uk	uk	uk	without	uk
N. stygia	beyond Exp-3	6:5	6:4	1/2 Exp	uk	1.3	uk	1/4 Enp-1; bipinnate; ~Enp	2	with, large	uk
N. hamata	beyond Exp-3	6:5	uk	1/4 Exp	basis	4.4	uk	1/2 Enp-1; unipinnate; ~ Enp	3	without	2
N. elegans	beyond Exp-3	6:5	6:4	1/3 Exp	basis	1.9	uk	2/3 Enp-1; bipinnate; > Enp	3	without	1
N. sonmezi	beyond Exp-3	6:5	uk	1/2 Exp	basis	1.7	Without	2/3 Enp-1; plumose; ~1/2 Enp-3	3	without	1
N. loweae	~Exp-3	6:5	6:5	1/3 Exp	basis	1.5	Without	1/4 Enp-1; pinnate; > Enp	3	without	1
N. serdarsaki	beyond Exp-3	uk	6:4	uk	allobasis	uk	Without	2/3 Enp-1; unipinnate; ~Enp	3	without	1
N. alperi	beyond Exp-3	6:5	uk	1/2 Exp	basis	1.7	with	2/3 Enp-1; unipinnate; ~Enp	3	without	1

Table 3. Differentiating characters of the species of the *lacustris* subgroup. uk = unknown.

Species	P1 Enp-1	P5 female Exp:Benp	P5 male Exp:Benp	Female P5 Benp:Exp	A2	A2 Exp-2	Female P6	Inner seta Enp-1 P1	Anal operculum	CR
	relative length	# setae	# setae	relative length	allobasis/ basis	# setae	# setae	position, ornamentation, and relative length	ornamentation	l/w
***N. duyxuyenensis* sp. nov.**	~Exp-2	6:5	6:3	1/2 Exp	allobasis	3	1	1/2 Enp-1; bipinnate; ~Enp-2	6 strong spinules	~1
N. karanovici	2/3 Exp-3	5:5	6:3	1/3 Exp	basis	3	1	3/4 Enp-1; plumose; ~Enp-3	11 strong spinules	~1
N. evergladensis	~Exp-2	6:5	7:4	2/3 Exp	basis	3	uk	2/3 Enp-1; smooth; ~1/2 Enp-3	7 strong spinules	~1
N. balli	1/2 Exp-3	5:4	5–6:2	1/3 Exp	basis	3	2	2/3 Enp-1; smooth; ~Enp-2	9–11 spinules	~0.7
N. pseudospinipes	1/2 Exp-2	6:3–4	5–6:3	1/3 Exp	basis	3	uk	1/2 Enp-1; smooth; ~1/2 Enp-3	8 small spinules	0.4
N. lacustris pacifica	1/2 Exp-2	6:5	6:2	1/2 Exp	basis	uk	1	uk	2–4 large spines	1.5
N. fallaciosa baltica	~Exp-2	5:5	6:4	uk	uk	uk	2	2/3 Enp-1; smooth; > Enp-3	~10 spinules	1.3
N. minor	beyond Exp-3	5:5	5:2	uk	uk	3	uk	2/3 Enp-1; smooth; ~1/2 Enp-2	11 spinules	~0.7
N. phreatica	~Exp-3	5:3	4:2	uk	uk	3	uk	2/3 Enp-1; smooth; ~Enp-2	12 spinules	~1
N. psammophila	1/2 Exp-3	6:5	6:3	1/2 Exp	uk	3	uk	1/2 Enp-1; smooth; ~Enp-3	~6 spinules	1.2
N. uenoi	~Exp-2	5:4	uk	1/2 Exp	basis	2	1	3/4 Enp-1; smooth; ~Enp-2	11 spinules	1.2

Table 4. Differentiating characters of the species of the *fragilis* subgroup. uk = unknown.

Species	P1 Enp-1	Female P5 Exp:Benp	Male P5 Exp:Benp	Female P5 Benp	A2	Female P6	Inner seta P1 Enp-1	P1 Enp-3	Anal operculum	CR
	relative length	# setae	# setae	relative length	allobasis/ basis	# setae	position, ornamentation, and relative length	# setae	ornamentation	l/w
N. australis	~Exp--3	5:5	6:4	1/2 Exp	basis	3	2/3 Enp-1; plumose; ~Enp-3	3	~22 large spinules	~0.7
N. fragilis	1/2 Exp-3	5:5	6:3	1/2 Exp	basis	uk	2/3 Enp-1; smooth; ~Enp-3	2	~12 spinules	~0.7
N. intermedia	2/3 Exp-3	5:5	6:3	1/2 Exp	allobasis	uk	2/3 Enp-1; bipinnate; ~Enp-3	3	~7–8 spinules	uk
N. husmanni	~Exp-2	6:5	6:3	~2/3 Exp	uk	uk	2/3 Enp-1; bipinnate; ~Enp-2	3	~7 spinules	~1
N. pietschmani	1/2 Exp-2	6:5	6:3	2/3 Exp	allobasis	uk	2/3 Enp-1; plumose; ~Enp-3	3	~4–6 spinules	~1
N. laingensis	uk	5:4	uk	1/2 Exp	uk	2	uk	uk	6 large spinules	~1
N. koreanus	~Exp-2	6:5	6:3	1/3 Exp	allobasis	uk	2/3 Enp-1; bipinnate; ~Enp-3	3	4–5 spinules	~1
N. taylori	2/3 Exp-2	6:5	6:2	1/3 Exp	allobasis	2	2/3 Enp-1; bipinnate; > Enp-3	3	3 strong spinules	1.2
N. vietnamensis	1/2 Exp-3	6:5	6:3	1/2 Exp	allobasis	2	2/3 Enp-1; bipinnate; ~Enp-3	3	5–6 strong spinules	~1
N. puebloviejensis	2/3 Exp-3	5:5	6:4	1/2 Exp	basis	1	1/2 Enp-1; bipinnate; ~Enp-3	3	5–6 spinules	~1
N. spinipes	1/2 Exp-3	5:5	6:5	1/2 Exp	basis	3	2/3 Enp-1; bipinnate; > Enp-3	3	8–12 spinules	~1
N. sphaeromata	beyond Exp-3	5:5	5:4	1/2 Exp	basis	uk	2/3 Enp-1; unipinnate; ~Enp-2	3	With row spinules	~1
N. reunionensis	~Exp-2	5:4	6:2	1/2 Exp	uk	1	2/3 Enp-1; bipinnate; ~Enp-2	3	~7 large spinules	~1
N. humphreysi	~Exp-2	4–5:4	5–6:3	1/2 Exp	basis	1	2/3 Enp-1; bipinnate; ~Enp-3	3	~5 strong spines	~1
N. quangnamensis	2/3 Exp-3	6:4	5–6:3	1/2 Exp	basis	1	1/2 Enp-1; bipinnate; ~Enp-2	3	6 strong spines	~1

Table 5. Differentiating characters of the species of the *mediterranea* subgroup. uk = unknown.

Species	P1 Enp-1	P2–P4 Enp-1	P2–P4 Enp-3	P2–P4 Exp-3	P4 Exp-3	Female P5 Exp:Benp	Female P5 Benp	Male P5 Exp:Benp	A2
	relative length	# inner setae	# setae	# setae	# inner setae	# setae	relative length	# setae	allobasis/ basis
N. mediterranea jakubisiak	uk	1-1-1	5-4-5	6-6-6	1	6:5	uk	uk	uk
N. mediterranea mediterranea	~Exp-3	1-1-1	4-4-5	6-6-6	1	6:5	1/2 Exp	5:4	basis
N. typica adriatica	2/3 Exp-3	1-1-1	4-4-4	6-6-6	1	6:5	1/3 Exp	6:4	uk
N. elongata	~Exp-3	1-1-1	4-4-4	6-6-7	2	5:5	1/2 Exp	6:4	basis
N. langi	uk	1-1-1	4-4-4	4-6-7	2	5:5	uk	uk	uk
N. fluviatilis	~Exp-2	1-1-1	3-3-3	5-5-7	2	6:4	1/2 Exp	6:3	basis
N. kastjanensis	~Exp-2	0-0-0	5-5-5	7-7-7	2	5:5	uk	6:3	basis
N. quadriseta	~Exp-3	0-0-0	4-4-4	7-7-7	2	5:5	uk	6:4	basis
N. cari	~Exp-3	0-0-0	3-5-5	7-7-8	3	6:4	uk	5:2	uk
N. arctolongus	~Exp-2	0-0-0	3-4-5	7-7-7	2	5:5	1/3 Exp	6:2	allobasis
N. yeelirrie	1/2 Exp-2	0-0-0	3-4-4	7-7-7	2	6:4	1/3 Exp	6:2	allobasis
N. bisetosa	~Exp-3	0-0-0	3-4-4	7-7-6	1	5:2	1/3 Exp	6:2	basis
N. esbe	~Exp-2	0-0-0	3-4-4	6-6-7	2	7:4	1/3 Exp	6:2	allobasis

The dense river network in Central Vietnam, originating from the Annamite Range, characterized by steep terrain and widespread sandy sediments, has created particularly favorable geomorphological and hydrological conditions for the formation and development of the hyporheic zone. This is an intermediate zone between surface water and groundwater, where metabolic processes and micro-flows take place, providing a stable habitat for many species of benthic organisms and plankton. To date, only four species of copepods (*Parastenocaris sontraensis* Tran, Trinh-Dang & Brancelj, 2021; *P. vugiaensis* Tran, Trinh-Dang & Brancelj, 2021; *Nitocra quangnamensis*, *Phyllognathopus vietnamensis* Tran, Nguyen & Brancelj, 2025) have been discovered from the hyporheic region in Vietnam, suggesting that the copepod biodiversity in this ecosystem remains considerably underestimated (Tran et al. 2025b).

Identification keys to the species groups and species of each subgroup of *Nitocra* are given below. The identification of the species of *Nitocra* is difficult mainly because of poor original descriptions of some species. The user is suggested to also check the original descriptions in case of doubt.

Key to the groups and subgroups of *Nitocra*

1 P1 Exp-3 with four spines/setae ..... **group I**
– P1 Exp-3 with five spines/setae **2**
2 P1 Exp-2 without inner seta ..... **group II**
– P1 Exp-2 with inner seta ..... **3 (group III)**
3 P2–P4 Enp-3 with 4:5:5 spines/setae **4**
– Number of spines/setae on P2–P4 Enp-3 different ..... ***mediterranea* subgroup**
4 P2–P4 Enp-1 without inner seta ..... ***lacustris* subgroup**
– P2–P4 Enp-1 with one inner seta **5**
5 P2–P4 Exp-3 with 7:7:8 spines/setae ..... ***affinis* subgroup**
– P2–P4 Exp-3 with 7:7:7 spines/setae ..... ***fragilis* subgroup**

Key to the species of the *affinis* subgroup

1 Inner middle seta of P4 Exp-3 not stronger, but longer than the other setae ..... ***N. rijekana***
– Inner middle seta of P4 exopod-3 stronger and longer than the other setae, and spinulose **2**
2 P5 Exp l/w ratio ≥ 4; syncoxa of maxilliped with 2 setae ..... ***N. hamata***
– P5 Exp l/w ratio < 4; syncoxa of maxilliped with 1 seta **3**
3 Rostrum with rostral projection **4**
– Rostrum without rostral projection **6**
4 A2 with allobasis ..... ***N. affinis***
– A2 with basis **5**
5 Inner seta of P1 Enp-1 bipinnate, inserted at distal 1/4 of segment, reaching beyond Enp-3; all setae of Enp P2–P4 smooth ..... ***N. colombiensis***
– Inner seta of P1 Enp-1 bipinnate, inserted at 2/3 of segment, reaching approximately the tip of Enp-3; all setae of Enp P2–P4 pinnate .... ***N. alperi***
6 P1 Enp-3 with 2 setae; P5 baseoendopod with large hyaline field ... ***N. stygia***
– P1 Enp-3 with 3 setae; P5 baseoendopod without hyaline field **7**

7 P1 Enp-1 barely reaching tip of Exp-3; inner seta of P1 Enp-1 inserted at distal 1/4 of segment ..... ***N. loweae***
– P1 Enp-1 reaching beyond tip of Exp-3; inner seta of P1 Enp-1 inserted at distal 2/3 of segment **8**
8 A2 with allobasis ..... ***N. serdarsaki***
– A2 with basis **9**
9 Inner seta of P1 Enp-1 bipinnate; female P5 baseoendopod reaching proximal 1/3 of Exp ..... ***N. elegans***
– Inner seta of P1 Enp-1 strongly unipinnate; female P5 baseoendopod reaching beyond 1/2 of Exp **10**
10 L/w ratio of female P5 Exp ~1.7, baseoendopod reaching the middle of Exp, with innermost seta shortest ..... ***N. sonmezi***
– L/w ratio of female P5 Exp ~2–2.2, baseoendopod not reaching proximal 2/3 of Exp, with outermost seta shortest ..... ***N. californica***

Key to the species of the *lacustris* subgroup

1 Female P5 Exp with 5 setae **2**
– Female P5 Exp with 6 setae **7**
2 P1 Enp-1 reaching beyond Exp-3 ..... ***N. minor***
– P1 Enp-1 at most as long as Exp-3 ..... **3**
3 A2 Exp one-segmented with 2 setae ..... ***N. uenoi***
– A2 Exp one-segmented with 3 setae **4**
4 Female P5, baseoendopod with 3 setae ..... ***N. phreatica***
– Female P5, baseoendopod with 4 or 5 setae **5**
5 Inner seta of P1 Enp-1 inserted at ¾ of segment; female and male P5 Exp and baseoendopod with 5 and 5, and 6 and 3 setae, respectively ..... ***N. karanovici***
– Inner seta of P1 Enp-1 inserted at 2/3 of segment; female and male P5 Exp and baseoendopod with different number of setae **6**
6 Female and male P5 Exp and baseoendopod with 5 and 4, and 5 or 6 and 3 setae, respectively; P1 Enp-1 reaching the middle of Exp-3 ..... ***N. balli***
– Female and male P5 Exo and baseoendopod with 5 and 5, and 6 and 4 setae, respectively; P1 Enp-1 reaching the tip of Exp-2 ..... ***N. fallaciosa baltica***
7 P1 Enp-1 reaching beyond Exp-2 ..... ***N. psammophila***
– P1 Enp-1 not reaching beyond Exp-2 ..... **8**
8 A2 with allobasis ..... ***N. duyxuyenensis* sp. nov.**
– A2 with basis **9**
9 Inner seta of P1 Enp-1 inserted at 1/2 of segment; female P5 baseoendopod with 3 or 4 setae ..... ***N. pseudospinipes***
– Inner seta of P1 Enp-1 inserted at 2/3 of segment; female P5 baseoendopod with 5 setae **10**
10 Male P5 Exp and baseoendopod with 7 and 4 setae, respectively; P1 Enp-1 reaching Exp-2 ..... ***N. evergladensis***
– Male P5 Exp and baseoendopod with 6 and 2 setae, respectively; P1 Enp-1 reaching ½ of Exp-2 ..... ***N. lacustris pacifica***

Key to the species of the *fragilis* subgroup

1 Female P5 Exp with 4–5 setae **2**
– Female P5 Exp with 6 setae **10**
2 Female P5 baseoendopod with 4 setae **3**
– Female P5 baseoendopod with 5 setae **5**
3 Female P6 with 2 setae ..... ***N. laingensis***
– Female P6 with 1 seta **4**
4 Male P5 Exp and baseoendopod with 6 and 2 setae, respectively ..... ***N. reunionensis***
– Male P5 Exp and baseoendopod with 5–6 and 3 setae, respectively ..... ***N. humphreysi***
5 A2 with allobasis ..... ***N. intermedia***
– A2 with basis **6**
6 P1 Enp-3 with 2 setae ..... ***N. fragilis***
– P1 Enp-3 with 3 setae **7**
7 P1 Enp-1 reaching beyond Exp-3 ..... ***N. sphaeromata***
– P1 Enp-1 not reaching beyond Exp-3 ..... **8**
8 Female P6 with 1 short seta; inner seta of P1 Enp-1 inserted midway inner margin of segment ..... ***N. puebloviejensis***
– Female P6 with 3 setae; inner seta of P1 Enp-1 inserted at distal 2/3 of segment **9**
9 P1 Enp-1 reaching approx. tip of Exp-3; male P5 Exp and baseoendopod with 6 and 4 setae, respectively ..... ***N. australis***
– P1 Enp-1 reaching the middle of Exp-3: male P5 Exp and baseoendopod with 6 and 5 setae, respectively ..... ***N. spinipes***
10 Female P5 baseoendopod with 4 setae ..... ***N. quangnamensis***
– Female P5 baseoendopod with 5 setae **11**
11 Male P5 baseoendopod with 2 setae ..... ***N. taylori***
– Male P5 baseoendopod with 3 setae **12**
12 P3 Exp-3 with middle outer seta not reaching beyond tip of segment; inner seta of P1 Enp-1 reaching approx. tip of Enp-2 ..... ***N. husmanni***
– P3 Exp-3 with middle outer seta reaching beyond tip of segment; inner seta of P1 Enp-1 reaching approx. tip of Enp-3 ..... **13**
13 Female P5 Exp rounded, baseoendopod reaching ~2/3 of Exp ..... ***N. pietschmanni***
– Female P5 Exp P5 ellipsoidal, baseoendopod reaching 1/2 or 1/3 of Exp ... **14**
14 P1 Enp-1 reaching tip of Exp-2; female P5 baseoendopod reaching ~2/3 of Exp, all setae pinnate; male P5 Exp with fifth seta from inner to outer shortest ..... ***N. koreanus***
– P1 Enp-1 reaching 1/2 of Exp-3; female P5 baseoendopod reaching ~1/2 of Exp, all setae smooth; male P5 Exp with second seta from inner to outer shortest ..... ***N. vietnamensis***

Key to the species of the *mediterranea* subgroup

1 P2–P4 Enp-1 with 1:1:1 inner seta, respectively **2**
– P2–P4 Enp-1 without inner seta **7**

2 P4 Exp-3 with 1 inner seta **3**
– P4 Exp-3 with 2 inner setae **5**
3 P2 Enp-3 with 5 setae..... ***N. mediterranea jakubisiak***
– P2 Enp-3 with 4 setae..... **4**
4 P4 Enp-3 with 5 setae; male P5 Exp and baseoendopod with 5 and 4 setae, respectively..... ***N. mediterranea mediterranea***
– P4 Enp-3 with 4 setae; male P5 Exp and baseoendopod with 6 and 4 setae, respectively..... ***N. typica adriatica***
5 P2–P4 Enp-3 with 3:3:3 setae/spines, respectively; female P5 Exp and baseoendopod with 6 and 4 setae, respectively ..... ***N. fluviatilis***
– P2–P4 Enp-3 with 4:4:4 setae/spines, respectively; female P5 Exp and baseoendopod with 5 setae each **6**
6 P2–P4 Exp-3 with 6:6:7 setae/spines, respectively ..... ***N. elongata***
– P2–P4 Exp-3 with 4:6:7 setae/spines, respectively ..... ***N. langi***
7 P4 Exp-3 with 1 or 3 inner setae..... **8**
– P4 Exp-3 with 2 inner setae **9**
8 P2–P4 Enp-3 with 3:5:5 setae/spines, respectively; P4 Exp 3 with 8 setae/spines; female and male P5 Exp and baseoendopod with 6 and 4, and 5 and 2 setae, respectively..... ***N. cari***
– P2–P4 Enp-3 with 3:4:4 setae/spines, respectively; P4 Exp-3 with 6 setae/spines; female and male P5 Exp and baseoendopod with 5 and 2, and 6 and 2 setae, respectively..... ***N. bisetosa***
9 A2 with allobasis **10**
– A2 with basis **12**
10 P2–P4 Exp-3 with 6:6:7 setae/spines, respectively ..... ***N. esbe***
– P2–P4 Exp-3 with 7:7:7 setae/spines, respectively **11**
11 P4 Enp-3 with 5 setae/spines; female P5 Exp and baseoendopod with 5 setae each..... ***N. arctolongus***
– P4 Enp-3 with 4 setae/spines; female P5 Exp and baseoendopod with 6 and 4 setae, respectively..... ***N. yeelirrie***
12 P2–P4 Enp-3 with 5:5:5 setae/spines, respectively; P1 Enp-1 reaching tip of Exp-2; female P5 Exp and baseoendopod with 6 and 3 setae, respectively ..... ***N. kastjanensis***
– P2–P4 Enp-3 with 4:4:4 setae/spines, respectively; P1 Enp-1 reaching tip of Exp-3; female P5 Exp and baseoendopod with 6 and 4 setae, respectively ..... ***N. quadriseta***

Additional information

Conflict of interest

The authors have declared that no competing interests exist.

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No ethical statement was reported.

Use of AI

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Data availability

All of the data that support the findings of this study are available in the main text.

References

Apostolov AG (1976) New species of Harpacticoida (Copepoda) from Bulgaria [Novye vidy Copepoda (Harpacticoida) iz Bolgarii]. Zoologicheskiy zhurnal [Зоологический журнал] 55: 453–458. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=72515

Behning AL (1936) Miscellanea aralo-caspica. Internationale Revue der Gesamten Hydrobiologie 33(3): 241–249. https://doi.org/10.1002/iroh.19360330303

Blanchard R, Richard J (1891) Faune des lacs salés d'Algérie. Cladocères et Copépodes. Mémoires de la Société Zoologique de France 4: 512–535. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=77829

Bodin P (1970) Copépodes harpacticoïdes marins des environs de la Rochelle. 1. Espéces de la vase intertidale de Chatelaillon. Tethys (Cornella de Llobregat) 2: 385–436. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=417

Boeck A (1865) Oversigt over de ved Norges Kyster iagttagne Copepoder henhørende til Calanidernes, Cyclopidernes og Harpactidernes Familier. Forhandlinger i Videnskabs-Selskabet i Kristiania 1864: 226–282. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=390

Bowman TE (1988) *Nitokra sphaeromata*, a new harpacticoid copepod crustacean associated with the wood-boring isopod, *Sphaeroma peruvianum*, in Costa Rica. Proceedings of the Biological Society of Washington 101: 171–175. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=78500

Boxshall GA, Halsey SH (2004) An Introduction to Copepod Diversity. The Ray Society, London: 970. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=78616

Bozic B (1964) Copépodes harpacticoïdes et cyclopoïdes de la Réunion. II. Plage St. Pierre. Bulletin du Muséum National d'Histoire Naturelle 36: 481–499. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=71983

Bozic B (1969) Copépodes harpacticoïdes de la Réunion VI. Bulletin du Muséum National d'Histoire Naturelle 41: 867–882. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=71951

Brady GS (1880) A monograph of the free and semi-parasitic Copepoda of the British Islands. 2: 1–182. https://www.biodiversitylibrary.org/item/67810#page/7/mode/1up

Brady GS, Robertson D (1873) Contributions to the study of the Entomostraca. No. VIII. On marine Copepoda taken in the west of Ireland. Annals & Magazine of Natural History 12: 126–142. https://doi.org/10.1080/00222937308680724

Brehm V (1909) Copepoden aus den phlegräischen Feldern. Zoologischer Anzeiger 34: 420–423. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=78951

Brian A (1928) I Copepodi bentonici marini. Archivio Zoologico Italiano 12: 293–343. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=79185

Bruno MC, Reid JW, Perry SA (2002) New records of harpacticoid copepods from Everglades National Park (Florida, U. S. A.): Description of *Nitokra evergladensis*, new species (Ameiridae), supplementary description of *Attheyella americana*, and redescription of *Bryocamptus newyorkensis* (Canthocamptidae). Journal of Crustacean Biology 22(4): 834–854. https://doi.org/10.1163/20021975-99990296

Chang CY (2007) Two harpacticoid species of genera *Nitokra* and *Ameira* (Harpacticoida: Ameiridae) from brackish waters in Korea. Integrative Biosciences 11(2): 247–253. https://doi.org/10.1080/17386357.2007.9647341

Chappuis PA (1924) Description de deux Harpacticides nouveaux de Transylvanie. Buletinul Societatii de Stiinte din Cluj 2: 23–26. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=81072

Chappuis PA (1930) Copepoda Harpacticoida von der Insel Luzon, Philippinen. Philippine Journal of Science 41: 143–147. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=81363

Chappuis PA (1933) Suss- und Brackwasser Copepoden von Bonaire, Curaçao und Aruba. 1. Harpacticoida. In: Zoologische Ergebnisse einer Reise nach Bonaire, Curaçao und Aruba im Jahre 1930. Zoologische Jahrbücher. Abteilung für Systematik, Ökologie und Geographie der Tiere 64: 391–404. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=81374

Chappuis PA (1942) Eine neue Methode zur Untersuchung der Grundwasserfauna. Acta Scientifica Mathematisch.-Naturwissenschaftlichen Universität Francisco Josephinae Koloszvar, Cluj 6: 1–7. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=81395

Chullasorn S, Kangtia P, Klangsin P (2014) A new species of *Nitokra* Boeck, 1865 (Copepoda: Harpacticoida: Ameiridae) from a brown alga in Thailand. Proceedings of the Biological Society of Washington 127(1): 122–137. https://doi.org/10.2988/0006-324X-127.1.122

Daday E (1906) Untersuchungen über die Copepodenfauna von Hinterindien, Sumatra und Java nebst einem Beitrag zur Copepodenkenntnis der Hawaii-Inseln (Reise von Dr. Walter Volz.). Zoologische Jahrbücher. Abteilung für Systematik, Geographie und Biologie der Tiere 24: 175–206. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=83164

Fiers F (1986) New and interesting copepods (Crustacea, Copepoda) from brackish waters of Laing Island (northern Papua New Guinea) Leopold III Biological Station, Laing Island - Contribution no. 196. Bulletin. Institut Royal des Sciences Naturelles de Belgique. Biologie 56: 99–120. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=86837

Fuentes-Reinés JM, Suárez-Morales E (2014) A new subspecies of *Nitokra affinis* Gurney, 1927 (Copepoda, Harpacticoida) from the Caribbean coast of Colombia. ZooKeys 378: 1–15. https://doi.org/10.3897/zookeys.378.6695

Fuentes-Reinés JM, Suárez-Morales E, Silva-Briano M (2022) A new species of *Nitokra* Boeck, 1865 (Copepoda, Harpacticoida, Ameiridae) from the Caribbean coast of Colombia. ZooKeys 1128: 111–127. https://doi.org/10.3897/zookeys.1128.86210

Galhano MH (1968) Two new interstitial Ameiridae (Copepoda Harpacticoidea) from Portugal. Publicaçoes do Instituto de Zoologia "Dr. Augusto Nobre" 104: 1–21. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=87806

Giesbrecht W (1882) Die freilebenden Copepoden der Kieler Foehrde. Johresbericht der Commission zur Wissenschaftlichen Untersuchung der deutschen Meere in Kiel 4: 89–168. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=88634

Gómez S, Carrasco NK, Morales-Serna FN (2012) A new species of *Nitocra* Boeck, 1865 (Harpacticoida, Ameiridae, Ameirinae) from South Africa, with notes on its ecology and remarks on the status of Nitocra sewelli husmanni Kunz, 1976. ZooKeys 244: 33–58. https://doi.org/10.3897/zookeys.244.2633

Gurney R (1927) Zoological Results of the Cambridge Expedition to the Suez Canal, XXXIII: Report on the Crustacea – Copepoda (Littoral and Semi-Parasitic). Transactions of the Zoological Society of London 22(4): 451–577. https://doi.org/10.1111/j.1096-3642.1927.tb00207.x

Humes AG (1953) Two new semiparasitic harpacticoid copepods from the coast of New Hampshire. Journal of the Washington Academy of Sciences 43: 360–373. https://doi.org/10.1126/science.11.265.158

Huys R (2021) John Berkeley James Wells – An appreciation of his contributions to harpacticoid diversity and systematics. In: Huys R (Ed.) Systematics and taxonomy of harpacticoid copepods – A commemorative volume in honour of Prof. John J. B. Wells, Zootaxa. Magnolia Press, Auckland, New Zealand, 11–40. https://doi.org/10.11646/zootaxa.5051.1.5

Huys R, Boxshall GA (1991) Copepod evolution. The Ray Society, London, 468 pp. https://doi.org/10.4319/lo.1993.38.2.0478

Jakobi H (1956) Novas espécies de Harpacticoidea (Copepoda-Crustacea) provenientes de regioes de água salobra da costa Sao Paulo-Paraná. (Neue Harpacticoiden-Arten (Copepoda-Crustacea) aus den Brackwassergebieten der Küste Sao Paulo-Paraná). Dusenia 7: 159–171. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=94255

Jakubisiak S (1929) Sur les Harpacticidae observés en Pologne. Bulletin de la Société Zoologique de France 1969: 191–193. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=94285

Jakubisiak S (1938) Les harpacticoïdes de la Mer Noire (Côtes Roumaines). Annales Scientifiques de l'Université de Jassy 24: 387–402. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=91461

Jaschnov VA (1935) Fauna of brackish-water basins of the Wrangel Island. Fauna solonovatovodnykh vodoemov ostrova Vrangelya. Issledovaniya Morei SSSR 22: 119–134. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=94372

Karaman S (1934) Die Bathynelliden von Skoplje. Sonderdrück aus den Mitteilungen über Höhlen und Karstforschung 5: 26–30. https://eurekamag.com/research/022/391/022391252.php?srsltid=AfmBOoqBYWjPTsmuGcjQAepL5NXHmbYamfKb2-FqS4BZRZggzTp6iXqb

Karanovic T, Pesce GL (2002) Copepods from ground waters of Western Australia, VII. *Nitokra humphreysi* sp. nov. (Crustacea: Copepoda: Harpacticoida). Hydrobiologia 470(1–3): 5–12. https://doi.org/10.1023/A:1015694015451

Karanovic T, Eberhard S, Cooper SJB, Guzik MT (2015) Morphological and molecular study of the genus *Nitokra* (Crustacea, Copepoda, Harpacticoida) in a small palaeochannel in Western Australia. Organisms, Diversity & Evolution 15(1): 65–99. https://doi.org/10.1007/s13127-014-0193-3

Kiefer F (1929) Neue Ruderfusskrebse von den Sunda-Inseln. (1. Mitteilung über Copepoden der Sunda-Expedition Rensch-Heberer). Zoologischer Anzeiger 84: 46–49. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=96424

Klie W (1937) Ostracoden und Harpacticoiden aus brackigen Gewässern an der bulgarischen Küste der Schwarzen Meeres. Mitteilungen aus den Königlichen Naturwissenschaftlichen Instituten 10: 1–42. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=97196

Kornev PN, Chertoprud EC (2008) Copepod crustaceans of the order Harpacticoida of the White Sea: morphology, systematics, ecology. In: Biology Faculty MSU (Ed.) Tovarishchestvo Nauchnikh Izdanii KMK, Moscow, 379 pp. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=123748

Kunz H (1976) Eine neue Unterart der Gattung *Nitocra* (Copepoda, Harpacticoidea) aus Noordeutschland. Gewässer und Abwässer 60/61: 27–34. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=72913

Kunz H (1983) Harpacticoiden (Crustacea: Copepoda) aus dem litoral der Azoren. Arquipelago 4: 117–208. http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Harpacticoiden+(Crustacea:+Copepoda)+aus+dem+litoral+der+azoren#0

Lang K (1965a) Copepoda Harpacticoidea aus dem Küstengrundwasser dicht bei dem Askölaboratorium. Arkiv för Zoologi 18: 73–83. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=72932

Lang K (1965b) Copepoda Harpacticoidea from the Californian Pacific coast. Kungliga Svenska Vetenskapsakademiens Handlingar (4)10: 1–560. http://www.vliz.be/imis/imis.php?refid=78667

Liddell J (1912) *Nitocrameira bdellurae*, nov. gen. et sp., a copepod of the family Canthocamptidae, parasitic in the egg-cases of Bdellura. Journal of the Linnean Society of London, Zoology 32(213): 87–94. https://doi.org/10.1111/j.1096-3642.1912.tb01770.x

Marcus A (1968) Copepoda from the midlittoral zone of the Black Sea-Rumanian shore. I. *Nitocra elongata* n. sp. Travaux du Museum d'Histoire Naturelle "Grigore Antipa" 9: 15–24. https://www.luciopesce.net/pdf22/marcus2.pdf

Marcus A, Por FD (1961) Die Copepoden der polyhalinen Lagune Sinoe (Schwarzes Meer-Rümanische Küsten). Acta Musei Macedonici Scientiarum Naturalium 7: 105–126. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=101299

Mielke W (1993) Species of the taxa *Orthopsyllus* and *Nitocra* (Copepoda from Costa Rica). Microfauna Marina 8: 247–266. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=103161

Mielke W (1997) Interstitial fauna of Galapagos. XL Copepoda, part 8. Mikrofauna Meeresbondens 11: 153–192. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=103170

Miura Y (1962) Subterranean harpacticoid copepods of the Amami group of the Ryukyu Islands. Annotationes Zoologicae Japonenses 35: 95–105. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=103735

Noodt W (1952) Subterrane Copepoden aus Norddeutschland. Zoologischer Anzeiger 148: 331–343. [Subterrane Copepoden aus Norddeutschland]

Petkovski TK (1954) Harpacticiden des Grundwassers unserer Meereskuste. Acta Musei Macedonici Scientiarum Naturalium, Skopje 2: 93–123. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=107951

Por FD (1964) The genus *Nitocra* Boeck (Copepoda, Harpacticoida) in the Jordan Rift Valley. Israel Journal of Zoology 13: 78–88. https://doi.org/10.1080/00212210.1964.10688191

Por FD (1968) Copepods of some land-locked basins on the islands of Entedebir and Nocra (Dahlak Archipelago, Red Sea). Sea Fishery Research Station in Haifa Bulletin 49: 37–41. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=992

Reid JW (1988) Cyclopoid and Harpacticoid Copepods (Crustacea) from Mexico, Guatemala, and Colombia. Transactions of the American Microscopical Society 107(2): 190–202. https://doi.org/10.2307/3226461

Rouch R (1972) Deux Harpacticides nouveaux de l'île de Long-Island (Territoire de Papouasie et de Nouvelle-Guinée). Archives de Zoologie Expérimentale et Générale 113: 147–164. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=111642

Sars GO (1905) Pacifische Plankton-Crustaceen. (Ergebnisse einer Reise nach dem Pacific. Schauinsland 1896–1897). II. Brackwasser–Crustaceen von den Chatham-Inseln. Zoologische Jahrbücher für Systematik 21: 371–414. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=471

Sars GO (1911) Copepoda Harpacticoida. Parts XXXI & XXXII. Supplement (continued). An account of the Crustacea of Norway, with short descriptions and figures of all the species. 5: 369–396. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=477

Sars GO (1927) The fresh-water Entomostraca of the Cape Province (Union of South Africa). Part III: Copepoda. Annals of the South African Museum 25: 85–149. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=110577

Schäfer HW (1936) Harpacticoiden aus dem Brackwasser der Insel Hiddensee (Vorläufige Mitteilung). Mitteilungen des Naturwissenschaftlichen Vereins für Neuvorpommern und Rügenin Greifswald 63–64: 16–19. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=403

Schmankevitsch VI (1875) Nekotoryya rakoobraznyya solyano-ozernykh' i presnykh vod' i otneshenie ikh' k' srede. Some Crustacea of salt and freshwater lakes, and their relation to the surrounding environment. Zapiski Novorossiiskago Obshchestva Estestvoispytatelei (= Mémoires de la Société des Naturalistes de la Nouvelle Russie, Odessa) 3: 1–391. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=111238

Schmeil O (1894) Einige neue Harpacticiden-Formen des Süsswassers. Zeithschrift für Naturwissenschaften 67: 341–350. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=85133

Scott T (1905) On some new and rare Crustacea from the Scottish seas. Reports of the Fishery Board for Scotland 23: 141–153. https://dn720001.ca.archive.org/0/items/onsomenewandrarecr00scot/onsomenewandrarecr00scot.pdf

Sewell RBS (1924) Crustacea Copepoda: Fauna of the Chilka Lake. Memoirs of the Indian Museum, Calcutta 5: 771–851. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=113341

Shen C, Tai A (1973) Preliminary analysis of the characteristics of the harpacticoid Copepoda fauna of China and description of some new species. Dong Wu Xue Bao 19: 365–484. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=113707

Soyer J (1975) Harpacticoïdes (Crustacés Copépodes) de l'archipel de Kerguelen. I. Quelques formes mesopsammiques. Bulletin du Muséum National d'Histoire Naturelle Sér 3(168): 1169–1223. https://doi.org/10.5962/p.278440

Tran DL, Chang CY (2012) Two new species of harpacticoid copepods from anchialine caves in karst area of North Vietnam. Animal Cells and Systems 16(1): 57–68. https://doi.org/10.1080/19768354.2011.621979

Tran N, Trinh-Dang M, Brancelj A (2021) Two new species of *Parastenocaris* (Copepoda, Harpacticoida) from a hyporheic zone and overview of the present knowledge on stygobiotic Copepoda in Vietnam. Diversity 13(11): 534. https://doi.org/10.3390/d13110534

Tran NS, Nguyen TTV, Brancelj A (2025a) A new species of the genus *Phyllognathopus* (Copepoda, Harpacticoida) from central Vietnam. The Raffles Bulletin of Zoology 73: 293–303. https://doi.org/10.26107/RBZ-2025-0021

Tran N-S, Trinh-Dang M, Nguyen TTV, Brancelj A (2025b) A new species of *Nitokra* Boeck, 1865 (Copepoda: Harpacticoida: Ameiridae) from a hyporheic zone in central Vietnam. Zootaxa 5590(1): 46–60. https://doi.org/10.11646/zootaxa.5590.1.2

Walter TC, Boxshall G (2025) World of Copepods Database. *Nitokra* Boeck, 1865. Accessed through: World Register of Marine Species. https://www.marinespecies.org/aphia.php?p=taxdetails&id=157705 [on 2025-09-19]

Wells JBJ (1967) The littoral Copepoda (Crustacea) of Inhaca, Island, Mozambique. Transactions of the Royal Society of Edinburgh 67(7): 189–358. https://doi.org/10.1017/S0080456800024017

Wells JBJ, Rao GC (1987) Littoral Harpacticoida (Crustacea: Copepoda) from Andaman and Nicobar Islands. Memoirs of the Zoological Survey of India 16: 1–385. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=119979

Willey A (1930) Harpacticoid Copepoda from Bermuda. Part I. Annals & Magazine of Natural History 6(31): 81–114. https://doi.org/10.1080/00222933008673192

Wilson CB (1932) The copepods of the Woods Hole region, Massachusetts. Bulletin – United States National Museum 158(158): 1–635. https://doi.org/10.5479/si.03629236.158.i

Yeatman HC (1983) Copepods from microhabitats in Fiji, Western Samoa, and Tonga. Micronesica 19: 57–90. https://www.marinespecies.org/aphia.php?p=sourcedetails&id=121232

Yıldız NÖ, Karaytuğ S (2024) Taxonomic revision of the *Nitocra affinis* Gurney, 1927 species complex (Harpacticoida, Ameiridae) with descriptions of four new species and re-evaluation of its subspecies. ZooKeys 1191: 35–74. https://doi.org/10.3897/zookeys.1191.115545